CHAPTER III

AN ANALYSIS OF ALTERNATIVE COMPENSATION PLANS

The Navy provides nuclear officer incentive pay, along with some other types of special pay, in an attempt to ensure sufficient retention to offset its projected shortages of nuclear-trained officers. The Navy believes that NOIP is essential in recruiting and retaining the nuclear officers it needs.[1] But under the program, the Navy expects to have only 85 percent of the nuclear submarine officers it requires next year and only 72 percent of the nuclear surface officers. The percentage will increase slightly for submarine officers by the end of the decade but will worsen for surface officers. Given those projections, together with today's tight budget environment and what could be viewed as the Navy's overly broad requirements for nuclear officers, the Congress may wish to consider whether the NOIP program could be changed without significantly affecting the Navy's supply of nuclear-trained officers.

ALTERNATIVE BONUS PLANS

To cover the range of possible alternatives, the Congressional Budget Office (CBO) examined three possible bonus plans for nuclear submarine and surface officers in addition to the current program.

Alternative Plans for Nuclear Submarine Officers

Under the NOIP program, nuclear submarine officers who agree to remain in the Navy under a three-, four-, or five-year contract receive continuation pay of $10,000 per year (see Table 10). Those officers who opt to extend without a contract receive an annual incentive bonus of $7,200. Alternative 1 would decrease COPAY to $7,200 a year under a four-year contract and the AIB to $6,000 a year.[2] Alternative 2 would offer a slightly lower COPAY of $6,000 per year for a four-year contract but no AIB. The rationale underlying that plan is to encourage officers who would

1. Statement of Vice Admiral Frank L. Bowman, Chief of Naval Personnel, before the Subcommittee on Personnel of the House Committee on National Security, March 14, 1995.

2. In all of the alternative plans analyzed in this paper, the current accession bonus would remain in effect regardless of changes in COPAY and the AIB.

TABLE 10. CURRENT NUCLEAR OFFICER INCENTIVE PAY PROGRAM AND THREE ALTERNATIVE PLANS

	Current Program	Alternative 1	Alternative 2	Alternative 3
		Nuclear Submarine Officers		
Continuation Pay	$10,000 per year for three-, four-, or five-year contract	$7,200 per year for four-year contract	$6,000 per year for four-year contract	0
Annual Incentive Bonus	$7,200 per year without a contract	$6,000 per year without a contract	0	0
		Nuclear Surface Officers		
Continuation Pay	$10,000 per year for three-, four-, or five-year contract	$6,000 per year for four-year contract	$4,000 per year for four-year contract	0
Annual Incentive Bonus	$7,200 per year without a contract	$3,200 per year without a contract	0	0

SOURCE: Congressional Budget Office.

otherwise extend their service without a contract to do so instead with a contract. Such a move would result in more contracted years of service, which in turn would ensure a more stable force over time. Alternative 3 would do away with both continuation pay and the annual incentive bonus.

Alternative Plans for Nuclear Surface Officers

Because the Navy's projected shortfall of nuclear officers is smaller for surface ships than for submarines, CBO examined less generous alternatives for surface officers (see Table 10). Alternative 1 would provide a $6,000 per year COPAY for officers reenlisting under a four-year contract and a $3,200 per year AIB for those extending without a contract. Under Alternative 2, officers would receive COPAY of $4,000 a year but no AIB. Alternative 3 would eliminate both COPAY and AIB for nuclear surface officers.

CBO's Method of Analysis

CBO used data from several sources to analyze the effects of the alternative bonus plans. Its major source of data was the Navy's Officer Master Tapes, which contain a great deal of information about the demographic, educational, and military characteristics of nuclear officers. CBO also relied on data from the Census Bureau for information about employment conditions and compensation in the civilian sector and on a survey of salaries received by civilian nuclear engineers.

CBO evaluated the various bonus plans using a model of officer retention (described in greater detail in the appendix) that was developed at the Center for Naval Analyses and later refined at the Navy Personnel Research and Development Center (NPRDC). CBO used results from the model that were provided by NPRDC. The model is based on the notion that nuclear officers approaching their minimum service requirement (MSR) of four years or later decision points are faced with the decision to remain in the Navy or leave the service. If they choose to remain, they also decide simultaneously between staying with or without a contract and the accompanying bonus plan. In the model, the decision to stay or leave is determined by officers' choosing the alternative that maximizes their satisfaction ("utility" to economists). The utility that officers can expect in turn depends on their military pay (including a bonus, if any) and nonmonetary factors that affect retention. The model was estimated using the multinomial logit technique. (See the appendix for the variables included in the analysis and more detail on the estimation and results.)

IMPACT OF THE ALTERNATIVE PLANS

Because all three alternative plans would reduce continuation pay and the annual incentive bonus from their current levels, they would yield savings to the government compared with the current NOIP program (see Tables 11 and 12). Alternative 3 would result in the largest savings--up to $49 million over the 1997-2000 period for the surface and submarine communities combined--since it would eliminate payments for both COPAY and AIB. Alternative 1 would come the closest to matching the current program in terms of the percentage of total and nuclear-specific billets filled as well as the number of officers who would remain in the service at the MSR point. It would save $12 million over the four-year period. Alternative 2 falls in between the first and the third on both savings and number of officers.

Perhaps the most surprising finding is that Alternative 3, which would eliminate the bonuses, would still manage to satisfy well over 200 percent of the Navy's nuclear-specific requirements and nearly 80 percent of its total requirements for submarine officers and 60 percent for surface officers. Compared with the current

TABLE 11. EFFECTS OF ALTERNATIVE BONUS PLANS FOR NUCLEAR SUBMARINE OFFICERS

	Current Plan ($10,000 COPAY, $7,200 AIB)		Alternative 1 ($7,200 COPAY, $6,000 AIB)		Alternative 2 ($6,000 COPAY, no AIB)		Alternative 3 (No COPAY or AIB)	
	1997	2000	1997	2000	1997	2000	1997	2000
Number of Nuclear Officers at MSR who								
Stay	231	159	222	152	198	136	180	123
Leave	106	73	115	80	139	96	157	109
Nuclear Officers as a Percentage of Billets Requiring Nuclear Training[a]	259	282	256	272	253	265	247	249
Nuclear Officers as a Percentage of Total Billet Requirements	85	87	84	84	84	82	82	77
Cost of Plan (In millions of dollars)								
1997	18		17		14		14	
2000	15		11		7		1	
Total, 1997-2000	65		56		41		25	

SOURCE: Congressional Budget Office based on data from the U.S. Navy.

NOTE: COPAY = continuation pay; AIB = annual incentive bonus; MSR = minimum service requirement.

a. The Navy identifies these positions with an Additional Qualification Designator/Nuclear Subspecialty Code.

TABLE 12. EFFECTS OF ALTERNATIVE BONUS PLANS FOR NUCLEAR SURFACE OFFICERS

	Current Plan ($10,000 COPAY, $7,200 AIB)		Alternative 1 ($6,000 COPAY, $3,200 AIB)		Alternative 2 ($4,000 COPAY, no AIB)		Alternative 3 (No COPAY or AIB)	
	1997	2000	1997	2000	1997	2000	1997	2000
Number of Nuclear Officers at MSR who								
Stay	45	47	34	35	21	22	20	21
Leave	44	46	55	58	68	71	69	72
Nuclear Officers as a Percentage of Billets Requiring Nuclear Training[a]	287	284	279	263	272	244	269	238
Nuclear Officers as a Percentage of Total Billet Requirements	72	68	70	63	68	59	67	57
Cost of Plan (In millions of dollars)								
1997	3		3		2		2	
2000	3		2		1		0	
Total, 1997-2000	12		9		6		3	

SOURCE: Congressional Budget Office based on data from the U.S. Navy.

NOTE: COPAY = continuation pay; AIB = annual incentive bonus; MSR = minimum service requirement.

a. The Navy identifies these positions with an Additional Qualification Designator/Nuclear Subspecialty Code.

NOIP, it would retain just 50 and 25 fewer officers, respectively, at the MSR point. Since only about one-third of the total billets for nuclear submarine officers and roughly one-fourth for nuclear surface officers require nuclear training, all three alternatives would yield enough officers to fill the critical billets as well as many of the career-enhancing assignments.

Nuclear Submarine Officers. All three alternative plans would satisfy nearly 80 percent of the total requirements for nuclear submarine officers as projected by the Navy. Moreover, both next year and at the end of the decade, each plan would greatly exceed the requirements for billets that must be filled by a submarine officer with nuclear training.

Alternative 1, which calls for a 28 percent decrease in COPAY, would fill 84 percent of the total requirements for nuclear submarine officers in 1997--only 1 percentage point less than the current bonus plan. Similarly, Alternative 1 would satisfy 256 percent of the nuclear-specific requirements--those with an Additional Qualification Designator/Nuclear Subspecialty Code (AQD/NSC)--compared with 259 percent for the current plan. Alternative 1 would result in just nine fewer nuclear submarine officers out of 337 remaining in the Navy at the critical MSR point in 1997 and seven fewer in 2000. That would be accomplished at a savings of $9 million over the 1997-2000 period.

The second alternative would eliminate payments for the AIB and at the same time reduce COPAY. Consequently, Alternative 2 would be less costly than Alternative 1, saving $24 million over four years. Compared with the current program, however, Alternative 2 would result in 33 more officers leaving the service at MSR in 1997. Nonetheless, it would still fill 84 percent of the total requirements and 253 percent of the nuclear-specific requirements.

Under Alternative 3, the Navy would no longer offer COPAY or the AIB. Thus, this plan would yield the most savings--$40 million over the 1997-2000 period. Even though 51 fewer nuclear submarine officers would remain in the Navy at MSR than under the current plan, Alternative 3 would more than satisfy the nuclear-specific billets (249 percent in 2000) and fill the great majority of the total requirements (77 percent in 2000).

Nuclear Surface Officers. The alternative plans for nuclear surface officers yield results comparable with those for nuclear submarine officers. All of the plans would fill well over 200 percent of the requirements for AQD/NSC billets, while satisfying nearly 60 percent or more of the total requirements.

Under Alternative 1, COPAY for nuclear surface officers would be reduced by 40 percent and the AIB by 56 percent. Even with those reductions, the Navy would still be able to fill 279 percent of its AQD/NSC requirements and 70 percent of its total requirements in 1997. By 2000, the percentages would be 263 and 63, respectively. Moreover, Alternative 1 would accomplish that by retaining only 11 fewer nuclear surface officers at the MSR decision point in 1997, and 12 fewer in 2000, than under the current bonus plan. Savings would total $3 million over the 1997-2000 period.

Alternative 2 calls for larger reductions (60 percent in COPAY and no payments for the AIB), which in turn would yield greater savings--$6 million through 2000. In addition, Alternative 2 would fill 272 percent of the nuclear-specific requirements for surface officers and 68 percent of the total requirements in 1997, while retaining 24 fewer officers at MSR. In 2000, it would satisfy 244 percent of the AQD/NSC requirements and 59 percent of the total requirements, with 25 fewer officers remaining in the service at MSR.

The third alternative would eliminate bonus payments for both COPAY and the AIB. Consequently, it would produce the largest savings--$9 million over four years. Otherwise, Alternative 3 would have a similar impact to Alternative 2 in terms of the percentage of requirements filled and the number of officers retained at MSR.

IMPLICATIONS FOR POLICY

As outlined above, CBO's analysis indicates that retention rates among nuclear-trained officers are relatively insensitive to the level and structure of the Navy's special pay. That finding suggests that the Congress and the Navy may want to examine targeted options that would use resources more efficiently. For example, special pay could be offered only to those nuclear-trained officers actually assigned to critical billets.[3] Such an approach might have less impact on retention than an across-the-board cut in COPAY and AIB because it would attract officers with a preference for sea duty. Thus, the Navy might be able to realize savings of the magnitude estimated above but with fewer officers deciding to leave the service.

Consideration of targeted bonuses might elicit a sharper analysis by the Navy of what its requirements for nuclear-trained officers really are. However, the Navy might view that approach, as well as any of the other alternatives examined by CBO, as disrupting its overall force management and the career planning of nuclear officers.

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3. The Navy has targeted other pay within a community; for instance, it targets bonuses for its pilots by type of aircraft.

APPENDIX

ANALYTIC METHOD

A nuclear officer nearing the completion of his minimum service requirement (MSR) or at a subsequent decision point must decide whether to remain in the Navy or leave the service. (There are no female nuclear-trained officers at present.) If the officer chooses to continue military service, he must decide on the contractual nature of his extension and its accompanying bonus. Currently, a nuclear officer can reenlist with a contract of three, four, or five years and receive a continuation pay (COPAY) bonus or extend without a contract and receive a nuclear career annual incentive bonus (AIB). In addition to the existing bonus program, the Congressional Budget Office (CBO) analyzed three alternative compensation plans.

CBO used data from the Navy's Officer Master Tapes as the major source of information on nuclear officers. More specifically, it used information on officers in the fiscal year 1974 through 1989 cohorts (officers with the same commissioning date). In addition, CBO used data from the Census Bureau's 1990 Public Use Microdata Samples and salary data on civilian nuclear engineers from a survey conducted by the National Society of Professional Engineers. Finally, CBO employed a model of officer retention that was developed at the Center for Naval Analyses and later refined at the Navy Personnel Research and Development Center (NPRDC). The model employs a variety of variables, which are summarized in Box A-1.

THE NUCLEAR OFFICER CONTINUATION MODEL

In the model CBO used, a nuclear officer at the end of his MSR or at a later decision point may choose to continue military service with a contract, extend without a contract, or leave the Navy. The model assumes that the officer will choose the option that maximizes his expected utility. The utility from each alternative outcome consists of two parts. The first component is the annualized income stream stem-

BOX A-1.
SUMMARY OF VARIABLES USED IN
THE NUCLEAR OFFICER CONTINUATION MODEL

Y_R	Real (inflation-adjusted) salary in 1989 dollars for male, college-educated veterans who are civilian professionals or engineers.
DEPEND	Number of dependents.
Y_C	Real military salary in 1989 dollars for an extension with a contract.
Y_{NC}	Real military salary in 1989 dollars for an extension without a contract.
USNA	A dummy variable equal to 1 if the officer came from the Naval Academy.
ROTC	A dummy variable equal to 1 if the officer came from the Reserve Officer Training Corps.
WHITE	A dummy variable equal to 1 if the officer is white.

ming from the option.[1] The second is the monetary equivalent (expressed in dollars) of the annualized value of the nonmonetary factors associated with the outcome.

1. In the case of submarine officers under a four-year contract, this component would equal the annualized value of regular military compensation plus submarine duty incentive pay plus continuation pay. For surface officers under a four-year contract, the annualized income would be computed similarly but without submarine duty pay. Assuming an income stream $Y_1, \ldots, Y_T$ and a discount rate r, the annualized discounted value of the stream can be written as:

$$Y^* = \sum_{t=1}^{T} Y_t(1+r)^{-t} \Big/ \sum_{t=1}^{T} (1+r)^{-t}$$

It follows that a constant income stream of Y^* has the same present discounted value over T periods as the original income stream,

$$\sum_{t=1}^{T} Y^*(1+r)^{-t} = \sum_{t=1}^{T} Y_t(1+r)^{-t}$$

CBO's analysis assumed a discount rate of 10 percent.

Moreover, the process of annualization allowed CBO to reduce income streams to a summation measure that is independent of the time horizon. Thus, it could compare income streams generated over different time periods, such as a four-year horizon of reenlistment with a contract and a one-year horizon of an extension without a contract. For more details, see John Warner, *Alternative Military Retirement Systems: Their Effects on Enlisted Retention*, Research Contribution 376 (Alexandria, Va.: Center for Naval Analyses, September 1979).

Thus, the expected utility (EU) for each possible decision is:

$$EU_C = Y_C + \Theta_C \quad (1)$$

$$EU_{NC} = Y_{NC} + \Theta_{NC} \quad (2)$$

$$EU_R = Y_R + \Theta_R \quad (3)$$

where Y_C is annualized military income over the period of continued service with a contract, Y_{NC} is annualized military income over the period of an extension without a contract, and Y_R is annualized civilian income.[2] The annualized monetary equivalents of the nonmonetary factors are represented by Θ_C, Θ_{NC}, and Θ_R. Those nonmonetary factors can be explained in part by a vector (X) of variables representing measurable characteristics of the service member and an unmeasured disturbance (δ) stemming from unobservable variables and remaining errors. The observable variables include the number of dependents, years of education, race, and source of commission. Those nonmonetary factors can be approximated in linear form for the *ith* outcome for the *jth* nuclear officer as follows:

$$\Theta_i = \beta_i X_j + \delta_{ij} \quad (4)$$

Thus, the expected utility for each possible decision becomes:

$$EU_C = Y_C + \beta_C X + \delta_C \quad (5)$$

$$EU_{NC} = Y_{NC} + \beta_{NC} X + \delta_{NC} \quad (6)$$

$$EU_R = Y_R + \beta_R X + \delta_R \quad (7)$$

At the completion of the MSR and subsequent decision points, a nuclear officer will reenlist with or without a contract if EU_C is greater than EU_R or EU_{NC} is greater than EU_R. Otherwise, the officer will resign from the Navy. Multinomial

2. The measures of pay used in this analysis do not include retirement income (either military or civilian). In general, as long as military retired pay is greater than its civilian counterpart, omitting retirement income from the calculation serves to overstate the elasticity of continuation with respect to pay. For officers early in their careers, however, the receipt of retired pay is many years away, and thus its economic (present) value is so small that it has little effect on their decisions about staying in the service. For officers who are closer to retirement age, the value of retired pay is much greater, but because their continuation rates are very high, the elasticity of continuation with respect to pay (including retirement) is very low. Thus, omitting retirement income has little empirical impact, but to the extent that it matters, the analysis in this paper overestimates the effect of reducing bonuses to nuclear officers.

logit is used in estimating the parameters.[3] This maximum-likelihood procedure is preferable since it guarantees consistent estimates of parameters.[4]

The probability (P) that a nuclear officer will choose to extend his service with a COPAY contract can be represented as follows:

$$P_C = \frac{\exp(\alpha Y_C + \beta_C X)}{\exp(\alpha Y_R + \beta_R X) + \exp(\alpha Y_C + \beta_C X) + \exp(\alpha Y_{NC} + \beta_{NC} X)} \quad (8)$$

Similarly,

$$P_{NC} = \frac{\exp(\alpha Y_{NC} + \beta_{NC} X)}{\exp(\alpha Y_R + \beta_R X) + \exp(\alpha Y_C + \beta_C X) + \exp(\alpha Y_{NC} + \beta_{NC} X)} \quad (9)$$

is the probability of extending without a contract and receiving an annual incentive bonus instead.

Finally,

$$P_R = \frac{\exp(\alpha Y_R + \beta_R X)}{\exp(\alpha Y_R + \beta_R X) + \exp(\alpha Y_C + \beta_C X) + \exp(\alpha Y_{NC} + \beta_{NC} X)} \quad (10)$$

is the probability of resigning from the service.

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3. The multinomial logit model has as its basis the cumulative logistic probability function, which can be represented as follows:

$$P_i = \frac{1}{1 + e^{-(\alpha + \beta X_i)}}$$

where P_i is the probability that an individual will make a particular choice given information represented by X_i.

4. Robert S. Pindyck and Daniel L. Rubinfeld, *Econometric Models and Economic Forecasts*, 2nd ed. (New York: McGraw-Hill, 1981), p. 305.

CHANGES THAT AFFECT RETENTION

CBO's analysis focused on changes that the Navy can undertake that would have a favorable impact on the retention of nuclear officers. The two types of changes examined here are changes in military pay, which includes the Nuclear Officer Incentive Pay (NOIP) program, and changes in selected nonmonetary factors that may affect retention. The NOIP changes are explored further through selected elasticities.

Effects of Changes in Military Pay

To estimate the effects that changes in military pay (including bonuses) under a COPAY contract would have on the probability of nuclear officers' remaining in the Navy, CBO used the following formulations:

$$\frac{\partial P_R}{\partial Y_C} = -\alpha P_R P_C \qquad (11)$$

$$\frac{\partial P_{NC}}{\partial Y_C} = -\alpha P_{NC} P_C \qquad (12)$$

$$\frac{\partial P_C}{\partial Y_C} = \alpha P_C (1 - P_C) \qquad (13)$$

The positive sign on the coefficient α in equation (13) coupled with the negative signs for α in equations (11) and (12) means that an increase in military pay under a COPAY contract causes P_C to increase and overall retention to rise (by lowering the number of officers who leave, P_R), but leads to a decrease in P_{NC} (noncontract, AIB participation).

Likewise, the effects of changes in military pay under an AIB agreement on the probability of retention of nuclear officers can be represented as follows:

$$\frac{\partial P_R}{\partial Y_{NC}} = -\alpha P_R P_{NC} \qquad (14)$$

$$\frac{\partial P_C}{\partial Y_{NC}} = -\alpha P_C P_{NC} \qquad (15)$$

$$\frac{\partial P_{NC}}{\partial Y_{NC}} = \alpha P_{NC}(1 - P_{NC}) \qquad (16)$$

Accordingly, an increase in noncontract pay will increase AIB participation, lower COPAY participation, and increase retention.

Effects of Changes in Nonmonetary Factors in the Vector X

To capture the influences of the various nonmonetary factors on retention, CBO estimated the following equations:

$$\frac{\partial P_C}{\partial X_i} = \beta P_C(1 - P_C) \qquad (17)$$

$$\frac{\partial P_{NC}}{\partial X_i} = \beta P_{NC}(1 - P_{NC}) \qquad (18)$$

$$\frac{\partial P_R}{\partial X_i} = -\frac{\partial P_C}{\partial X_i} - \frac{\partial P_{NC}}{\partial X_i} \qquad (19)$$

Selected Elasticities

An important focus of CBO's analysis is the percentage change in the probability of an officer's staying in the Navy that results from a percentage change in the nuclear bonus--that is, the elasticity of staying with respect to an increase in the bonus. Similarly, the analysis is also concerned with the elasticity of staying with respect to a change in civilian income. CBO derived those critical elasticities in the following way.

If one begins with the equation $P_S = P_C + P_{NC}$, where P_S is the probability of staying in the military, the elasticity of staying with respect to civilian income is:

$$\epsilon_{P_S,Y_R} = \frac{Y_R}{P_S}\frac{\partial P_S}{\partial Y_R} \tag{20}$$

$$= \frac{Y_R}{P_S}\left[\frac{\partial P_C}{\partial Y_R} + \frac{\partial P_{NC}}{\partial Y_R}\right]$$

$$= \frac{Y_R}{P_S}\left[-\alpha P_C P_R - \alpha P_{NC} P_R\right]$$

$$= -\alpha P_R Y_R \frac{P_C + P_{NC}}{P_S}$$

$$= -\alpha P_R Y_R \frac{P_C + P_{NC}}{P_C + P_{NC}}$$

$$= -\alpha P_R Y_R \tag{21}$$

Similarly, the elasticity of staying in the military with respect to COPAY income is:

$$\epsilon_{P_S,Y_C} = \frac{Y_C}{P_S}\frac{\partial P_S}{\partial Y_C} \tag{22}$$

$$= \frac{Y_C}{P_S}\left[\frac{\partial P_S}{\partial Y_C} + \frac{\partial P_{NC}}{\partial Y_C}\right]$$

$$= \frac{Y_C}{P_S}\left[\alpha P_C(1 - P_C) - \alpha P_{NC} P_C\right]$$

$$= \alpha P_C Y_C \frac{1 - P_C - P_{NC}}{P_S}$$

$$= \alpha \frac{1 - P_S}{P_S} P_C Y_C \qquad (23)$$

Substituting Y_{NC} for Y_C in equation (23) yields the elasticity of staying in the military with respect to noncontract income:

$$\epsilon_{P_S, Y_{NC}} = \alpha \frac{1 - P_S}{P_S} P_{NC} Y_{NC} \qquad (24)$$

ESTIMATION OF THE MODEL

CBO's estimation of the nuclear officer continuation model is based primarily on information about nuclear officers in the fiscal year 1974 through 1989 cohorts contained in the Navy's Officer Master Tapes. The information was compiled by tracking nuclear officers by their Social Security numbers. After making several adjustments to the data, CBO was left with 6,755 observations as the basis for its estimation.[5]

The model was estimated separately for submarine and surface officers using maximum-likelihood methods (see Table A-1 for the mean values of the variables used in the estimation). Although most of the variables are self-explanatory, two require additional explanation. The civilian pay variable (Y_R) was estimated by ordinary least squares using a cross-sectional sample of veterans drawn from the Census Bureau's 1990 Public Use Microdata Samples. The sample was composed only of male veterans who were college graduates employed in engineering and managerial occupations. Y_R was assumed to have a four-year horizon and does not include bonuses or benefits. The estimating equation and resulting coefficients (t-statistics in parentheses) are as follows:[6]

5. Observations were dropped if officers had not yet completed their minimum service requirement, if they had left the service before their MSR, or if they had data missing from their file.

6. This equation was supplied by the Navy Personnel Research and Development Center. All of the coefficients far exceed statistical significance at the 5 percent level. A low R^2 such as the one here is quite common in cross-sectional analyses.

TABLE A-1. MEAN VALUES OF VARIABLES USED IN THE MODEL

Variable		Description	Mean Value: Submarine Model (N=5,448)	Mean Value: Surface Model (N=1,307)
CONTRACT	=	1, if staying in Navy at MSR with a 3-, 4-, or 5-year contract; 0, otherwise	.243	.166
NONCONTRACT	=	1, if staying in Navy at MSR without a 3-, 4-, or 5-year contract; 0, otherwise	.426	.394
LEAVE	=	1, if leaving Navy at MSR; 0, otherwise	.331	.440
Y_c	=	Annualized military pay over a 4-year horizon; military pay includes RMC, SUBPAY (submarines only), and COPAY (in fiscal year 1989 dollars)	$53,654	$48,853
Y_{NC}	=	Annualized military pay over a 1-year horizon; military pay includes RMC, SUBPAY (submarines only), and AIB (in fiscal year 1989 dollars)	$51,550	$46,755
Y_R	=	Annualized civilian earnings over a 4-year horizon (in fiscal year 1989 dollars)[a]	$24,575	$24,382
COPAY345	=	1, if MSR occurred in fiscal year 1986 or later; 0, otherwise	.604	.611
ACA	=	1, if U.S. Naval Academy accession; 0, otherwise	.374	.423
NROTC	=	1, if NROTC accession; 0, otherwise	.292	.324
WHITE	=	1, if officer is white; 0, otherwise	.952	.930
DEPEND	=	Number of dependents at MSR	.752	.640

SOURCE: Congressional Budget Office using data from the Navy Personnel Research and Development Center.

NOTE: MSR = minimum service requirement; RMC = regular military compensation; SUBPAY = submarine-duty incentive pay; COPAY = continuation pay; AIB = annual incentive bonus; NROTC = Navy Reserve Officers Training Corps.

a. Annualized civilian earnings represent the earnings that a nuclear officer with four years of military service and no civilian experience could expect to receive in 1989 dollars in civilian engineering and managerial positions. They are based on data from the Census Bureau. Alternatively, a civilian with 10 years of experience, the counterpart of a nuclear officer with the rank of lieutenant commander (O-4), could expect to earn $32,268 in fiscal year 1989 dollars. Similarly, the civilian counterpart of a commander (O-5) with 16 years of experience could expect earnings of $42,193. Table 9 shows similar income figures after those two figures were adjusted with wage and salary deflators.

$$\begin{aligned} LnY = {} & 9.7060 + 0.0701*MILEXP - 0.0014*MILEXP^2 + 0.0785*CIVEXP \\ & (132.62) \quad (6.74) \qquad\quad (-4.84) \qquad\quad (15.01) \\ & - 0.0013*CIVEXP^2 - 0.0025*MILEXP*CIVEXP - 0.2366*NONWHITE \\ & (-13.53) \qquad\quad (-7.18) \qquad\quad (-7.25) \\ & + 0.1053*BAPLUS \\ & (6.20) \end{aligned}$$

$R^2 = 0.064$

where:

LnY	= the natural logarithm of annual earnings in 1989 dollars
MILEXP	= years of military experience
CIVEXP	= years of civilian experience
NONWHITE	= 1, if the veteran was nonwhite; 0, otherwise
BAPLUS	= 1, if the veteran had more than a four-year degree; 0, otherwise

Since 1985, nuclear officers have had the option of a three-year or five-year contract along with a four-year contract. To capture the influence of the additional contract options, a dichotomous dummy variable (COPAY345) was constructed. COPAY345 takes on the value of 1 if a nuclear officer's MSR or subsequent retention decision occurred in fiscal year 1986 or later, and 0 otherwise.

Results of the estimations for nuclear submarine and surface officers facing the choice of whether to remain in the Navy at their minimum service requirement are presented in Tables A-2 and A-3. Similar estimations were undertaken to capture the continuation decisions of nuclear officers at subsequent decision points. The results of these estimations give rise to retention elasticities.

As an overall measure of the quality of the model's fit, the Chi-square (χ^2) statistic for both the submarine and surface estimations exceeds the 5 percent level of statistical significance. Likewise, many of the coefficients in the two estimations are statistically significant at the 5 percent level (see Tables A-2 and A-3). In particular, the coefficients on the compensation variables (Y_C, Y_{NC}, and Y_R) are positive and statistically significant.[7] However, they are rather small. Thus, although pay matters to an officer who is deciding whether to remain in the Navy, its impact

7. In accordance with the model presented above, the coefficients on the three compensation variables are the same.

TABLE A-2. ESTIMATION RESULTS FOR NUCLEAR SUBMARINE OFFICERS UNDER A CONTINUATION PAY CONTRACT OR ANNUAL INCENTIVE BONUS (t-statistics in parentheses)

Variable	COPAY Coefficient	AIB Coefficient
Constant	-3.373 (-6.533)	-1.424 (-3.016)
Y_C, Y_{NC}, Y_R	0.0000417 (2.790)	0.0000417 (2.790)
COPAY345	0.960 (13.078)	0.960 (13.078)
ACA	0.624 (5.913)	0.454 (4.764)
NROTC	0.256 (2.451)	0.285 (3.152)
WHITE	0.618 (3.004)	0.270 (1.622)
DEPEND	0.401 (9.364)	0.075 (1.900)
Log Likelihood Function		-5,642.102
Chi-square		408.18

SOURCE: Congressional Budget Office using data from the Navy Personnel Research and Development Center.

NOTE: COPAY = continuation pay; AIB = annual incentive bonus.

TABLE A-3. ESTIMATION RESULTS FOR NUCLEAR SURFACE OFFICERS UNDER A CONTINUATION PAY CONTRACT OR ANNUAL INCENTIVE BONUS (t-statistics in parentheses)

Variable	COPAY Coefficient	AIB Coefficient
Constant	-9.074 (-7.080)	-6.203 (-5.368)
Y_C, Y_{NC}, Y_R	0.0002015 (4.730)	0.0002015 (4.730)
COPAY345	1.196 (6.522)	1.196 (6.522)
ACA	0.990 (4.393)	0.368 (2.133)
NROTC	0.224 (0.924)	0.113 (0.655)
WHITE	1.669 (3.937)	1.469 (4.339)
DEPEND	0.376 (3.920)	0.032 (0.400)
Log Likelihood Function		-1,292.036
Chi-square		126.62

SOURCE: Congressional Budget Office using data from the Navy Personnel Research and Development Center.

NOTE: COPAY = continuation pay; AIB = annual incentive bonus.

is not very large. The coefficient on the COPAY345 variable is also positive and significant, which implies that the three-year and five-year contract options increase retention. The positive coefficient on the race variable (WHITE) suggests that white nuclear officers are more likely to stay in the Navy than their nonwhite counterparts.

Moreover, the coefficients on the Naval Academy accession variable (ACA) are positive and significant for the two nuclear communities in both contract and noncontract choices. That implies that Naval Academy accessions have a higher propensity to remain in the service than accessions from other sources. Similarly, accessions to the submarine community from the Navy Reserve Officers Training Corps (NROTC) have higher propensities for retention than other groups (the coefficients are positive and significant). That is not the case in the surface community, however.

Another implication of the estimation worth noting is that the variable representing the number of dependents that an officer had at his MSR (DEPEND) has positive coefficients in all cases, but for both communities they are only statistically significant in the contract choice. In general, that finding implies that the greater the number of dependents, the more likely an officer is to stay in the Navy. More specifically, the more dependents an officer has, the greater is his likelihood to remain in the Navy under a contract.

IMPACT OF ALTERNATIVE COMPENSATION PLANS

The nuclear officer continuation model used the estimated probabilities described above to derive retention elasticities (see Tables A-4 and A-5). CBO then evaluated the alternative plans by using the elasticities for each community, which were estimated by NPRDC, to adjust the continuation rates in each year-of-service cell for that community. Applying the adjusted continuation rates to the number of officers in a community yielded the number of officers under a specific compensation plan. CBO compared that figure with the projected number of officers under the current NOIP program to estimate the changes resulting from each compensation alternative.

TABLE A-4. RETENTION ELASTICITIES UNDER ALTERNATIVE BONUS PLANS FOR NUCLEAR SUBMARINE OFFICERS

Year of Service	Current Plan ($10,000 COPAY, $7,200 AIB)	Alternative 1 ($7,200 COPAY, $6,000 AIB)	Alternative 2 ($6,000 COPAY, no AIB)	Alternative 3 (No COPAY or AIB)
4	.696	.668	.595	.541
5	.865	.850	.844	.808
6	.732	.710	.701	.651
7	.721	.699	.689	.638
8	.922	.912	.908	.882
9	.937	.929	.925	903
10	.680	.671	.667	.644
11	.882	.869	.863	.830
12	.939	.931	.927	.906
13	.904	.892	.887	.858
14	.850	.834	.827	.790
15	.788	.769	.760	.715

SOURCE: Congressional Budget Office using data from the Navy Personnel Research and Development Center.

NOTE: COPAY = continuation pay; AIB = annual incentive bonus.

TABLE A-5. RETENTION ELASTICITIES UNDER ALTERNATIVE BONUS PLANS FOR NUCLEAR SURFACE OFFICERS

Year of Service	Current Plan ($10,000 COPAY, $7,200 AIB)	Alternative 1 ($6,000 COPAY, $3,200 AIB)	Alternative 2 ($4,000 COPAY, no AIB)	Alternative 3 (No COPAY or AIB)
4	.574	.431	.269	.255
5	.713	.677	.659	.620
6	.824	.796	.782	.750
7	.855	.830	.817	.789
8	.858	.834	.821	.793
9	.882	.861	.849	.824
10	.917	.900	.891	.871
11	.908	.890	.880	.858
12	.875	.853	.841	.815
13	.923	.907	.898	.879
14	.957	.947	.941	.928
15	.894	.874	.863	.840

SOURCE: Congressional Budget Office using data from the Navy Personnel Research and Development Center.

NOTE: COPAY = continuation pay; AIB = annual incentive bonus.